

Chip-Scale Packaging for AMD Flash Memory Products

The AMD Fine-pitch Ball Grid Array (FBGA)

The FBGA package offers system designers a chip-scale package for Flash memories that provides a significant reduction in board real estate over TSOP packages and provides many advantages over other chip-scale alternatives. The AMD FBGA package will be available for AMD's new Am29SL800 1.8 volt-only 8 megabit device, as well as a family of 3.0 volt-only Flash memory devices and selected 5.0 volt-only devices.

FBGA and μ BGA® Approaches

The two most popular Chip Scale Packaging alternatives are Fine Pitch BGAs (FBGAs) and μ BGAs.

The FBGA is constructed similar to conventional IC packages and is an extension of proven BGA technology. Existing equipment and proven manufacturing processes are employed. No new technology developments are required. A die is mounted on a substrate and the leads are bonded using gold wires. The device is then encapsulated in plastic and balls are attached (see Figure 1). The **minimum** package size is determined by the die size. The package can be extended beyond the die as needed to accommodate a manufacturing friendly ball grid array.

In contrast, a μ BGA package is constructed on the die itself (see Figure 2). A tape containing wire interconnects is attached to the die and the wire traces are bonded directly to the die. The **maximum** package size is determined by the die size. The ball grid array is, therefore, constrained by the die size.

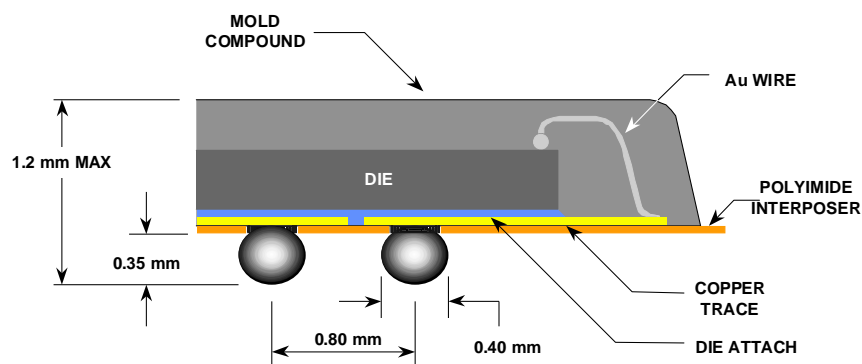


Figure 1. FBGA Construction

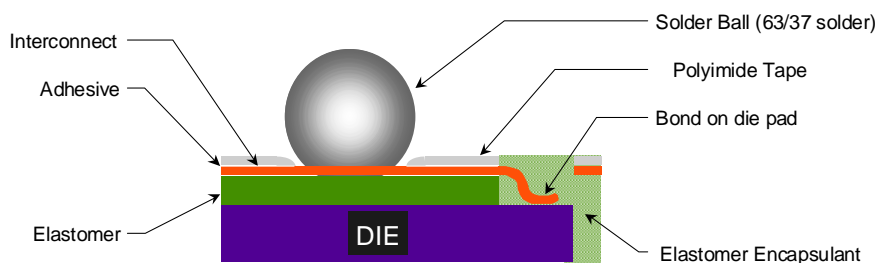


Figure 2. μ BGA Construction

The Impact Of Technology Migrations

There are many costs associated with the manufacture of a semiconductor device: die cost, assembly cost, test cost, finishing costs. The die cost typically has the most impact on the total manufacturing cost. In order to drive down the cost of the final product, semiconductor manufacturers continually migrate to state-of-the-art processes to reduce die size. Leading edge technology currently being used to manufacture Flash devices is 0.35 micron. By 1999, AMD will be converting all of its flash devices to 0.25 micron technology. The FBGA allows a smaller, lower cost die to be placed in the same package without affecting package dimensions. Smaller die always result in a smaller μ BGA package and usually a finer ball pitch.

Ball Pitch — User Considerations

The optimum distance between balls on a BGA, the ball pitch, is determined by the OEM's PC board technology and system routing complexity. Because Flash memories require a low ball count (less than 48), devices with ball pitches of 0.8 mm can be easily routed with today's most widely used and most cost effective PC board technology (FR4 with 5 mil lines and spaces). Although projections indicate that in 2000 and beyond 0.5 mm ball pitches may be economically feasible, these finer pitch devices currently add to both board and manufacturing costs.

The FBGA package has three major advantages over strictly die-sized packages:

- ❑ **The FBGA package is the most cost-effective Chip-Scale Package.**

The FBGA package allows die shrinks to be implemented with the associated cost reductions without impacting the package body size or ball pitch. Since the package remains unchanged the semiconductor manufacturer need not retool handling and testing equipment each time the die size changes due to die shrinks. Package re-qualifications are not needed and inventory management is minimized. Therefore,

although the FBGA package assembly cost is comparable to other Chip Scale Package alternatives, less costly die can be utilized and many hidden costs can be eliminated.

- ❑ **Product manufacturers using the FBGA package for Flash memory will never have to re-layout a board, retool a programmer or revise an assembly line because of an AMD die revision.**

Because FBGA packages are transparent to die shrinks, the system manufacturer can maintain the same programming and manufacturing equipment, processes and documentation. The packages will not have to be re-qualified and production lines will not be interrupted. In addition, a long-term guaranteed supply of spare parts assures that systems can be maintained indefinitely in the field. Smaller packages with finer ball pitches can be provided as die sizes shrink at the option and convenience of the user.

- ❑ **The FBGA package is the only chip-scale package suitable for all Flash memory densities**

Because of their smaller die size, lower density Flash memories do not have enough die area to place a usable ball grid array on a die-sized package. Using today's most economical 0.35 micron technology, only 8 megabit devices and above can be assembled in μ BGAs. When 0.25 micron devices are in widespread production in 1999 the minimum feasible density will grow to at least 16 megabits. In contrast, the Am29LV400, 4 megabit Flash memory, available in a 6 x 8 mm FBGA package, contains a 0.8 mm ball pitch array that is easily handled by standard SMT manufacturing techniques and is 1/3 the size of a TSOP package.

Relative Package Size — FBGA and μ BGA

For a given die the μ BGA will be the smallest form factor package in all three dimensions. However, because die sizes vary considerably from vendor to vendor each alternative must be evaluated individually. Because AMD's 8 and 16 megabit die are 30% smaller than the leading competitor's devices, AMD's FBGA products do, in fact, consume less board real estate than μ BGA solutions offered by other vendors. Since μ BGAs are not encapsulated they currently offer the thinnest solution at 1.0mm height.

Reliability

Both FBGA and μ BGA packages have demonstrated reliability levels suitable to most consumer and industrial applications. In some harsh thermal environments, μ BGA packages may provide better long term board level reliability. In situations where mechanical stress is present, devices in fully encapsulated FBGA packages may be more durable.

Standards

Many standards have been proposed for Chip Scale Packages. Because each Flash memory manufacturer's die is topologically different, it has been difficult to reach an accord. JEDEC and EIAJ have agreed on two different sets of standards for ball pitch. First generation FBGAs will have a 0.8 mm pitch and mBGAs will have a 0.75 mm pitch. Separate electrical footprint standards have been adopted for each package type. The standard for future generations of products in both packages will be 0.65 mm and 0.50 mm pitch ball grid arrays. Because of the construction differences, there will probably continue to be separate footprint standards for each package.

Multiple Sources

AMD and Fujitsu have agreed to cooperate on Chip Scale Packaging and will initially offer Flash Memories in identical packages at 4 megabit, 8 megabit and 16 megabit densities. Recently both Atmel and Micron Technology have announced their intentions to supply AMD compatible products in FBGA type packages with identical footprints as well.

Summary

By providing an economical Chip Scale Package that is substrate based, AMD is offering a superior small form factor solution for systems with demanding space constraints. Since FBGA package dimensions are transparent to die shrinks, the package is factory friendly and provides assurance of continued availability at the lowest possible cost of ownership.

Trademarks

µBGA is a registered trademark of Tessera Inc.

Copyright © 1998 Advanced Micro Devices, Inc. All rights reserved.

AMD, the AMD logo, and combinations thereof are registered trademarks of Advanced Micro Devices, Inc.

Product names used in this publication are for identification purposes only and may be trademarks of their respective companies.



*One AMD Place
P.O. Box 3453
Sunnyvale,
California 94088-3453
USA
(408) 732-2400
(800) 538-8450
TWX: 910-339-9280
TELEX: 34-6306*

TECHNICAL SUPPORT

*USA & CANADA non-PC CPU: (800) 222-9323
USA & CANADA PC CPU: (408) 749-3060
USA & CANADA PC CPU E-mail: hw.support@amd.com
EUROPE & UK: +44-(0)1276 803299
Fax: +44-(0)1276 803298
BBS: +44-(0)1276 803211
FRANCE: 0800 90 8621
GERMANY: 089-450-53199
ITALY: 1678-77224
EUROPE E-mail: euro.tech@amd.com
FAR EAST Fax: (852) 2956-0599
JAPAN: 03-3346-7550
Fax: 03-3346-7848
ARGENTINA: 001-800-200-1111,
after tone 800-859-4478
CHILE: 800-532-853
MEXICO: 95-800-222-9323*

LITERATURE ORDERING

*USA & CANADA: (800) 222-9323
EUROPE E-mail: euro.lit@amd.com
FAR EAST Fax: (852) 2956-0599
JAPAN Fax: 03-3346-9628*

www.amd.com

*Printed in USA
XXX-00-06/98
21627B*